Ministry of Education
Ontario

Hon. Bette Stephenson, M.D., Minister
Dr. H. K. Fisher, Deputy Minister

Curriculum Ideas for Teachers

1980

This support document to *The Formative Years*, one of a series dealing with the conservation of energy, provides information, student material, and suggestions to teachers for presenting this topic in the Junior Division.

Energy
J3

Clothing, Shelter, and Energy

Contents

Titles in this series are:

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Almost one-fifth of all energy consumed in Canada is used in our homes. More than half of the energy we use in our homes goes into heating and cooling. The other half is used for heating water, lighting, refrigerating, and operating appliances.

The shelters we have built around us enable us to live, work, relax, and study in relative comfort. They are designed to protect us and keep us warm. The clothes we wear serve the same function. When we buy clothes or a home, fashion will often play a role in what we purchase, but ultimately we are still meeting our basic human needs of shelter, warmth, and protection for our bodies.

The activities presented in this unit are designed to give students the opportunity of exploring our many reasons for having shelter and clothing. Through their work, the students will come to realize how important energy is in their lives. Through this and the other themes presented in this document, children will be provided with a real opportunity to investigate ways in which energy can be converted or conserved. They will also come to understand that their future lifestyles will not be able to depend on the same sources of energy that exist today, but that other exciting alternatives can be developed.

Throughout the different activities, lifestyle decisions are constantly being discussed. The conservation of energy and our dependence on it is brought out in all the topics. The possibilities of the future are also important (see, for example, activity sets 7 and 12). Our use of electricity in the home is reflected in three sets (3, 4, and 11).

The activities do not have to be done in any special sequence. Those based on the most easily understood concepts are found at the beginning of each set, but all of the activities are suitable (with slight modifications) to any Junior grade level. The nature of certain activity sets will restrict their use to certain seasons.

Name:

What Do You Know?

1. Why might we expect to live underground in the future?

2. Why do people who live in the desert wear many layers of clothing to keep cool?

3. What is the biggest energy user in your home?

4. Why is drying clothes on a clothes line better than drying them in an electric clothes dryer?

5. If you live in Northern Ontario, is it better to buy a black or a white car?

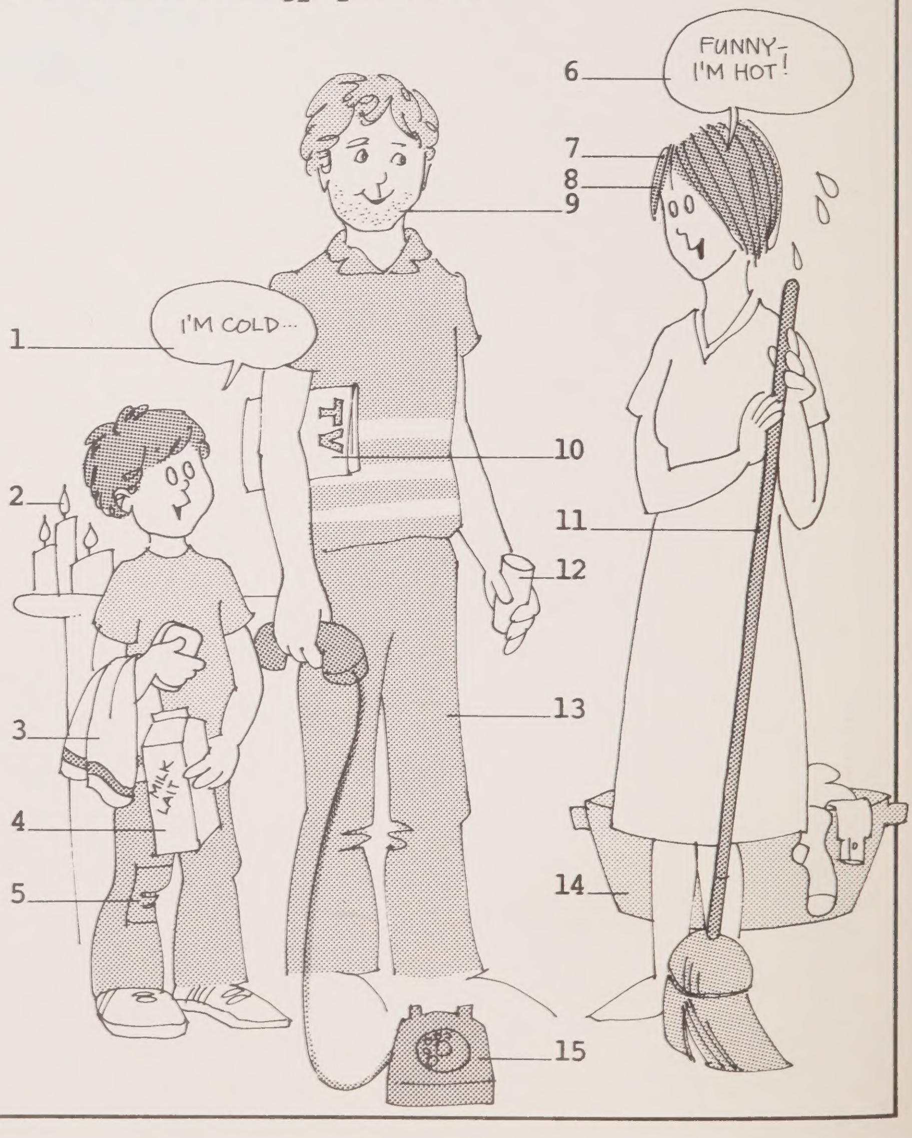
6. "Making something cool means making something else hot." What does this mean?

7. How can snow keep us warm?

8. If the sun provides us with more energy than our world will ever need, why is there a world energy problem?

9. For what type of weather are these people best dressed?

If you can't answer all the questions on this page, then the activity sets that follow are for you.



Each number stands for a way that energy may be used in your home. How many ways can you name?

Source: Energy, Mines and Resources Canada, Super Kids (Ottawa: Publishing Centre, Supply and Services Canada, 1976).

Name:

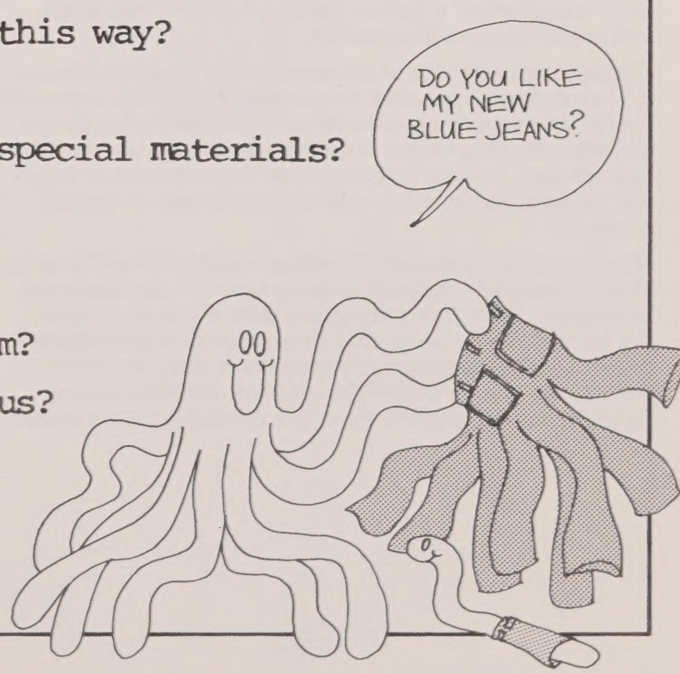
What to Wear Tomorrow?

"Here is tomorrow's weather report. It will be sunny and cool in the morning with temperature readings between 10°C and 15°C. In the afternoon it will begin raining and we will have heavy thunderstorms. The temperature will rise to 25°C. By evening, the temperature will drop to -5°C and snow is expected."

1. If you heard this weather report, what clothing would you wear tomorrow? Draw a picture of yourself dressed for tomorrow's weather.
2. Why did you decide to dress in this way?
3. Will you feel comfortable?
4. Will your clothes be made from special materials?

<u>Some other things to think about</u>:

1. Why do people wear clothes?
2. How do clothes help keep us warm?
3. How do clothes help to protect us?
4. If you never had to go outside, how would you dress?
5. Why don't animals wear clothes?



Notes

This activity was designed to help children learn to make wise selections of clothing, based on environmental conditions. The choice of appropriate dress is based on the need to insulate and protect the body. By choosing clothing that makes us feel comfortable, we can reduce the amount of energy we require for air-conditioning and heating.

We wear clothes for many reasons. A study of clothing and fashion will show that clothing patterns vary with the sex, age, economic position, race, and national and ethnic origin of the wearer, as well as with the era in which the wearer lives. Clothes also have meanings for people. They are a way of telling others about ourselves. Whatever we wear illustrates something about our values and self-concept (or, in the case of most children, those of their parents).

Often the real reason for wearing clothes is lost in our cultural concern for fashion. Belonging to a peer group, comfort, moods, the desire to change the body shape, and self-expression are all important factors in our choice of clothes. However, our main reasons for wearing clothing are to insulate and protect the body.

Clothing acts as insulation by providing a layer of warmth around the body. The tiny openings in the fabric act as an air conditioner at the same time by allowing the body to cool itself through the evaporation of perspiration. In cool weather, bulky, layered clothes should be worn. Fibres such as wool and kinked synthetics are better in cold weather than are smooth fibres such as nylon or polyester, because the great amount of air trapped within them acts as insulation. Furthermore, the moisture content of wool also adds to the feeling of warmth. Wool absorbs more moisture than synthetics and in doing so releases heat.

During warm weather, clothing that permits air to circulate and perspiration to evaporate is important. Lightweight, loosely woven fabrics and clothing that fits loosely will allow this to happen. Cotton is an excellent summer fibre, because it is loosely woven and absorbs moisture. Synthetic fibres, on the other hand, are poor moisture absorbers. Light-coloured clothing also contributes to warm-weather comfort, because it reflects heat and solar radiation.

Clothing protects us from many environmental hazards. The burning rays of the sun can cause considerable damage to the skin if it is not properly covered. The effects of wind, rain, and snow on the skin can be equally damaging. Clothing also acts as a "bump barrier" to protect the body from falls and bangs, and keeps it clean of dust and dirt.

Clothing is an extension of ourselves. At our stage of evolutionary development, we can no longer protect ourselves solely with the hair on our bodies in order to continue to live in this climate. Children should be helped to realize that clothing must be chosen with care, not only to meet society's expectations of fashion, but more importantly to protect and maintain our bodies' health.

When the children complete the student activity sheet "What to Wear Tomorrow?", they will probably have difficulty designing appropriate dress. The clothing they draw will be acceptable, but will probably not cover all of the environmental conditions described. Use the drawings to stimulate a class discussion on the reasons why we wear clothing and on how wise clothing decisions are important for the proper functioning of our bodies.

Follow-up Activities

1. Have children bring in outdoor clothing. Have them discuss how the clothing protects and insulates the body for the type of activity taking place. For example, they can consider such questions as how clothing for bicycling differs from that required for cross-country skiing, how swimming clothes differ from hockey clothes, as well as which activity requires the most body protectors and why these protectors are necessary.

2. Have children discuss whether they have arguments with their parents on what to wear to school. Ask them why these arguments occur; what their parents' concerns are; what their own concerns are; and who usually wins the arguments, and why.

3. Have the children choose one article of clothing that they are wearing and find out how it was made. They can use a map to locate the country in which the article was made, and do some research to find out the most important facts about making clothing in that country. They can write the manufacturer of the clothing to find out such information as what types of machines are used to make the clothing; where the fabric comes from; how important clothing manufacturing is to the country's people; and how the goods get to Canada.

4. Have children bring their favourite article of clothing to school, tell why it is their favourite, and explore its chief purpose, as well as any other purposes it has.

5. Have the children study clothing fashions from around the world in order to find out the reasons for the designs and fabrics used. Use such questions as the following: How do these fashions influence Canadian fashions? Do cultural groups living in Canada continue to wear some form of traditional dress? How do the Inuit maintain the same body temperature as people who live in the tropics? Why do people who live in desert countries cover much of their bodies in many layers of dark clothing?

Related Ideas

1. Have children study the coverings of animals. Ask them whether they can identify animals by their hair or fur. Why do they think many people object to killing animals for clothing?

2. Have children describe or draw clothes for the year 2000. They should consider how such clothes would be different from today's clothing.

3. The library can be used to obtain information about fashion design and changes through the centuries. Children can study uniforms and their changes and the fashions of different time periods. They can attempt to find clothing that is unique to Canada, such as capotes (the Hudson's Bay coats), parkas, sashes, mukluks, and tuques.


2

Name:

Close the Window! Shut the Door!

"Close the window!" "Shut the door!" How many times have you been told that? Why are people always telling us to do these things?

The windows and doors of your home and school have many uses.

Give five reasons for having windows:

1.

2.

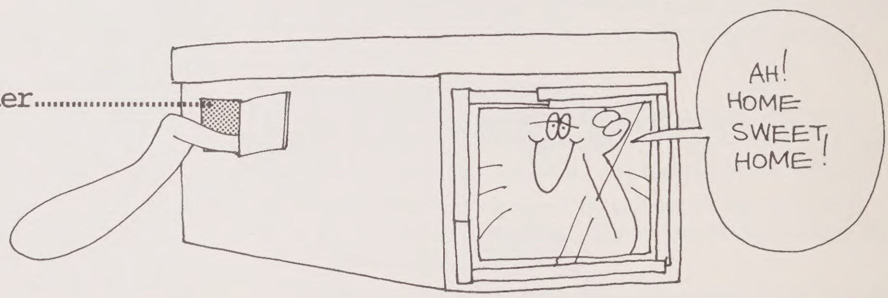
3.

4.

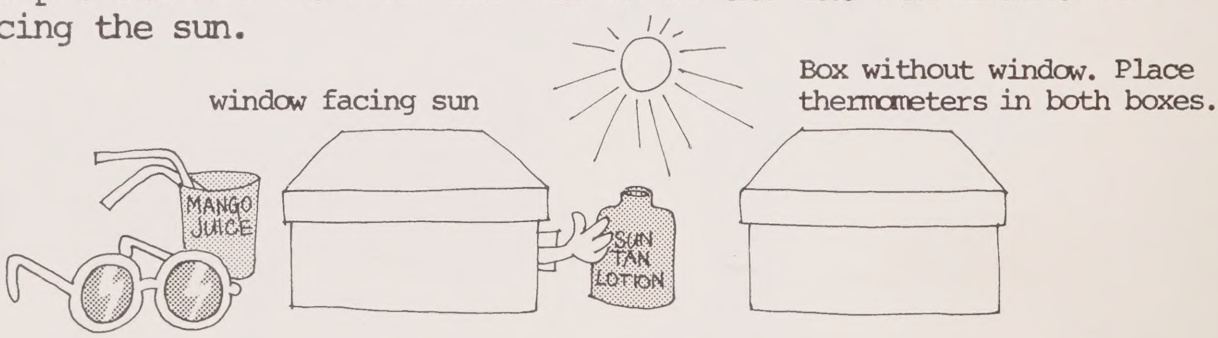
5.

Windows and doors can let a lot of heat out of a building. They also let a lot of heat in. How much hotter does a house with windows get than one without windows? Here's an activity to help you find out:

door for reading thermometer



Obtain two cardboard boxes of the same size. Shoeboxes will do. Cut a large hole in one side of one box. Cover it with clear plastic. Tape the plastic tightly to the box. Paint both boxes white or cover each with white paper. Put a thermometer in each and put them in the sun. The window of the one box should be facing the sun.



Record the temperature after 10 min, 20 min, and 30 min. What did you find out?

Close the Window!
Shut the Door!

Notes

We depend on windows and doors for many things. This set of activities shows students that doors and windows often cause as many problems during the year as they solve.

Windows and doors allow heat to escape in winter and to enter in summer, thus creating a load on the heating or cooling systems of the building. Solar energy also enters buildings *through* the windows and heats the air. In summer, the position of the windows can cause too much heat to enter, and we must find ways to keep it out – drapes and curtains, shutters, tinted glass. In winter, we wish as much solar heat to enter as possible, but if we build homes with large windows, we lose heat, particularly on cloudy days or at night. Eight times as much heat will pass through 1 m^2 (one square metre) of window area as will pass through 1 m^2 (one square metre) of wall. This assumes that the wall is insulated and that the window is double-glazed. Another problem arises when heat escapes through doors and windows that are improperly sealed or left open.

The number of windows, the direction of the placement of windows on walls, and the covering over of windows on the inside and outside of a building are all important factors in the lighting, heating, and ventilating of the building. Light must enter a building through its windows, although a building can be artificially lit. However, while a windowless building may conserve fuel energy for heating, it can sometimes be a depressing place for people to live or work in.

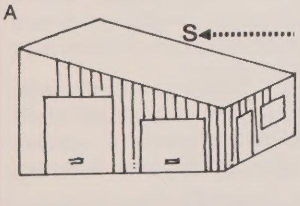
Doors, like windows, allow much heat to leave a building. Every time one is opened, heated air escapes and the interior air will need to be reheated. The types and locations of doors contribute to the amount of heat energy lost. Since our winds are generally from the west and north, cold winter air will enter more readily through doors with northern or western exposures, unless a vestibule entrance with two doors is built into the structure. In the same way, windows on the south side of buildings will allow more heat and light to enter than will windows that face north, east, and west.

The problems caused by windows and doors is becoming increasingly important to architects in our energy-conserving world. To come up with new systems that allow solar-heat energy to enter a building through windows, that prevent interior heat from being lost, that keep air vented and circulated without the use of energy, and that provide bright, well-lit structures is a major challenge today.

In completing this set of activities, students should work in small groups. Ideally, the cardboard boxes suggested should be shoeboxes, but any boxes will do. The boxes should have a small "door" on the side so that the interior temperatures can be read without having to remove the box lids. Choose a sunny day to conduct the investigations, since the results are more noticeable then than on a cloudy day. (Students may want to prove this for themselves.)

The follow-up activities extend the window investigation, so the shoeboxes can continue to be used.

A



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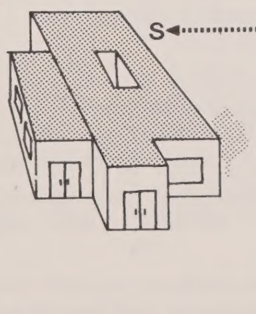


Follow-up Activities

1. How much hotter does a house get when the windows face south instead of north? Using the shoeboxes, have students cut windows in both boxes and cover the openings with plastic. The boxes, with a thermometer in each, can then be placed in the sun – one window facing south and the other facing north. The temperature should be recorded after 10 min, 20 min, and 30 min intervals. The students can compare their findings to those recorded when the boxes were placed in east-west directions. Ask students whether the time of day makes any difference to the readings.

2. Does the use of curtains and drapes help to control the temperature of a home? Students can find out by using the two shoeboxes with windows. Over one of the plastic windows, a piece of cloth is placed to act as a curtain. The two boxes are then placed in the sun facing south. The temperature is recorded in each box after 10 min. The students can now determine whether the use of curtains and drapes makes any difference by comparing the temperatures in the two boxes.

3. The students can now add a roof to one of the windowed boxes, placing it so that the overhang covers part of the window. The temperature readings of a roofed box are then compared with one that does not have a roof. Have students try different-sized roofs and overhangs. How would the overhang affect this investigation at different times of the year?

4. Have children look at the illustrations of buildings below. All the homes are well insulated. Have the children discuss the cooling and heating problems of each building to determine which would be the best lit and which would provide the best ventilation without using electricity. S = sun's position.

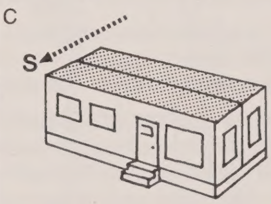
Related Ideas

1. Have students make a study of doors and windows. They can focus on such questions as the following: How are they made? Of what materials are they made? How are doors decorated?

2. Have students make a collection of doors from around the world by using photographs from magazines. Ask them what the doors tell them about the people who live or work behind them.

3. Have children estimate the number of times the doors of their homes are opened every day. By computing the area of each door, they can determine how much space is opened each day to allow heat to escape (area times number of door openings). Have the students suggest how this could be reduced.

C



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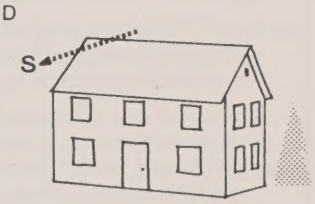

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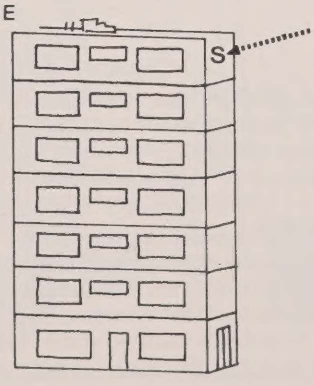

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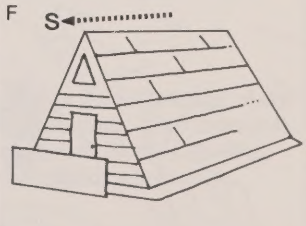
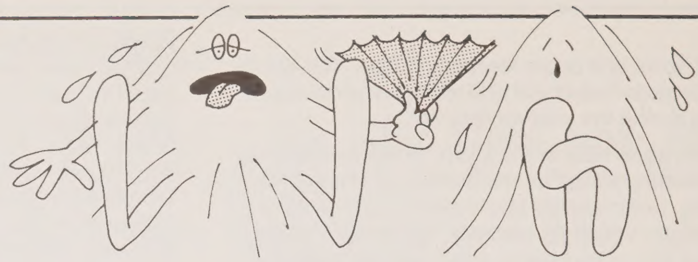


Name:

Keep Cool!



1. At what temperature do you begin to feel "too warm" in the summer?

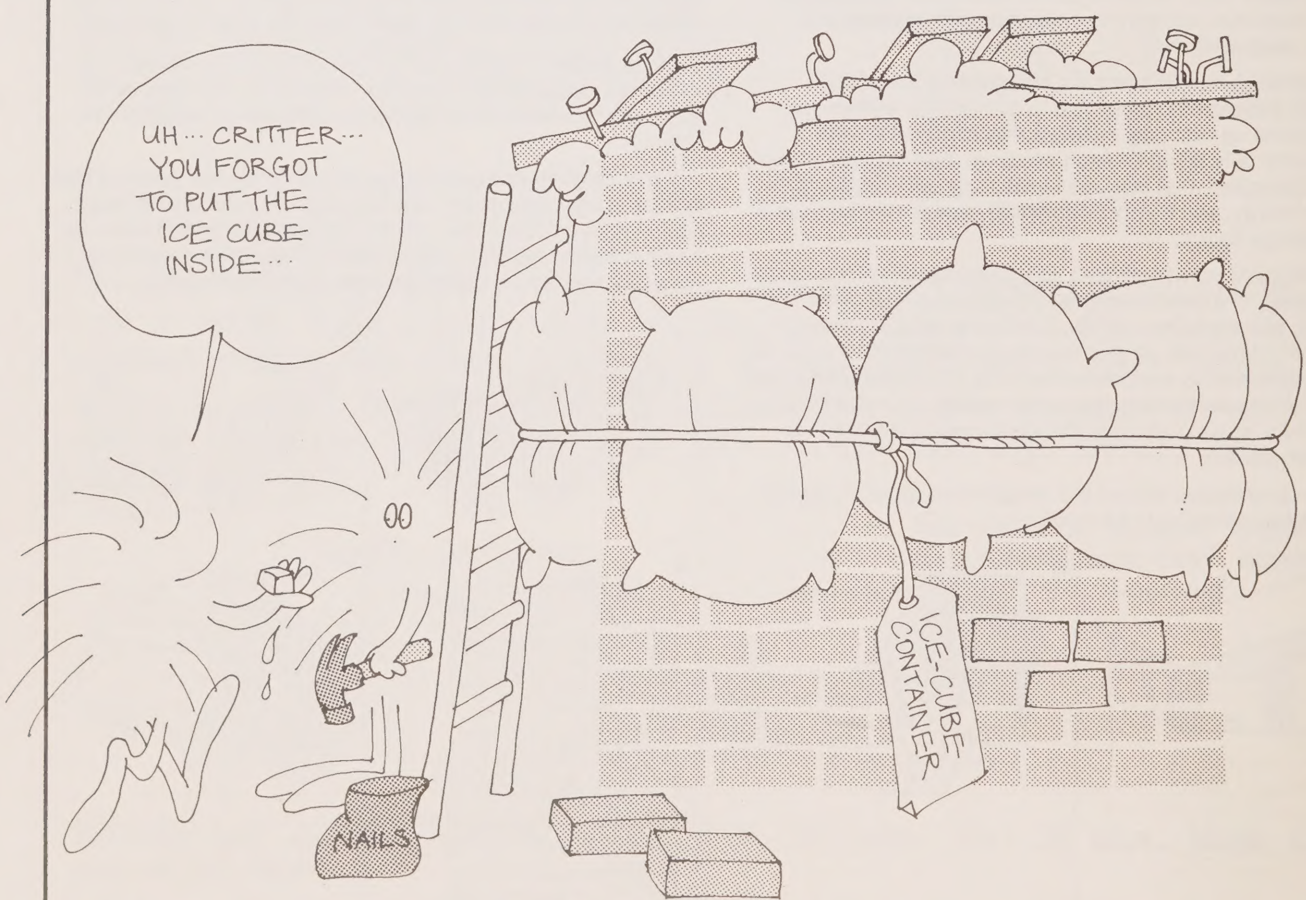
2. What are some of the things you do to keep cool?

Here is an activity you can do to find some ways of keeping cool.

It's an ice-cube-melting contest!

Here is the challenge. Can you make a container that will keep one ice cube from melting for 2 h? You may use any materials you wish (except your refrigerator) to build the container.

After two hours, open your container. Did you succeed? Who managed to keep the ice cube from melting the longest? What materials did he or she use? Why do you think these materials worked best?



Notes

The purpose of this activity is to have students explore ways of preventing heat from entering a container. Through a discussion of this activity, children can explore the relative effectiveness of various kinds of building and insulating materials. Other methods of keeping cool are also investigated. Keeping ourselves, our buildings, and our food cool is energy-consuming and must be done efficiently and effectively if energy is to be conserved.

The radiant heat from the sun during the summer months can cause great discomfort. During a heat wave, our electrical-energy-oriented society turns to the air conditioner to relieve the heat build-up. An air conditioner takes heat energy from the inside of a building and puts it outside, using the same principle as the refrigerator does. But air conditioning is costly – the machinery itself is expensive, as is the cost of the electrical energy needed to run it.

Heat build-up in homes during the daytime can reach as high as 55°C in the attic. This attic heat radiates downward to heat the rest of the living areas. After sundown, the heat from the attic continues to radiate, causing the upstairs to remain most uncomfortable. It may be cooler outside, but the trapped heat inside continues to cause discomfort to the occupants.

Some ways of cooling a home in summer are suggested by Ontario Hydro in *Summer Cooling:*

Bathroom Exhaust Fan
Turn on the bathroom exhaust fan or open the bathroom window after bathing. Be sure the bathroom door is closed. After several minutes, turn the fan off or close the window so that conditioned air from other rooms is not lost unnecessarily. Plastic shower curtains or glass doors are preferable to canvas or cloth, which absorb water and add to the moisture in your home.

Kitchen Vent Fan
When you cook on top of the range, a vent fan will exhaust heated air directly to the outside and relieve the burden on your cooling system.

Attic Vent Fan
When it's 35°C outside, the temperature in your attic can be as high as 55°C. This layer of heat makes it more difficult to cool your living space. An attic fan – whether it's at a window, gable vent, or through the wall or roof – will put that hot, dead air out of the attic and reduce your attic temperature by as much as 20°C. Your air conditioner doesn't have to run as often when it isn't fighting a hot attic.

Window Fans
Except for the attic vent fan mentioned above, never run window fans open to the outside when the air conditioning is on. You can use fans to distribute cooled air from rooms with window units to rooms without them.

Insulation
Proper insulation is just as important in keeping your house cool in summer as it is in keeping it warm in winter. Make sure your insulation is up-to-date.

Keep Drapes Closed
Keep the hot summer sun outside by closing curtains during the day. This simple measure will avoid unnecessary heat gain from sunshine flooding through a picture window.

Students should be aware that our increasing use of air conditioning probably represents the largest single factor in our increased use of electrical energy.

Feeling cool in the summer depends on the way you dress and the type of activity you engage in. The human body perspires to keep cool, so help it out by wearing clothing that will absorb moisture and reflect heat energy. Light cotton clothing is best. Other ways of keeping cool with little expenditure of energy include:

- Slowing down and relaxing. The body should not be allowed to perspire more than it needs to;
- having a cool shower or a swim and then finding a shady spot to sit down.

Keeping food cool requires an insulated container to keep the heat out. The heat is then removed from this container (the refrigerator). Electrical or gas energy is required to take the heat out of the refrigerator until the refrigerator reaches the desired temperature. Every food item that is put into the unit, unless it is already frozen, must have the heat taken from it. Like air conditioners, refrigerators are very energy-consuming. We should be constantly trying to develop ways of using such appliances more efficiently.

In the student activity, the whole class should build the containers and be given the ice cubes at the same time. This will avoid problems caused by different-sized ice cubes and different outside temperatures affecting the rate of melting. The contest may go on longer than 2 h, but the students should check to see what has happened at the end of that time. If the ice cubes are still not totally melted, the lids should be replaced and the cubes re-examined every half hour.

This activity introduces the problems of trying to keep heat out. Emphasis should be placed on the fact that the students' containers were not expected to keep the ice cube from melting for very long periods of time. What would they have had to do to keep the ice cube from melting for two days?

Follow-up Activities

1. The realization that the sun is responsible for our summer heat problems is important. On a sunny day, have students take a thermometer and measure the temperature in sunny and shady places around the schoolyard and in the classroom. Have them find answers to questions such as the following: Where is the temperature reading the highest? Where is it the lowest? What caused the temperature differences?

2. How much warmer do things get in the sun than in the shade? Have students pour equal amounts of cold water into two styrofoam cups. A thermometer is then placed in each cup. One cup is set in the sun and the other in the shade. The temperatures, recorded at 5 min intervals for a total of 20 min, are then graphed. Ask the students what differences they notice.

3. Have students develop a "summer keep-cool plan" that does not use electrical energy. What helpful suggestions can they share with each other regarding their homes and clothing?

4. Have students study the home refrigerator and answer the following questions: What things does it contain that need not be there? If the refrigerator setting were turned down to the next warmest setting, how much of the food would spoil? (If the answer is none, perhaps the refrigerator should be turned down.)

Related Ideas

1. Have children use the library to explore the technology of the air conditioner, the refrigerator, and the freezer. Their research should allow them to answer such questions as the following: What is a compressor? What gases or liquids are used to remove the heat from the air?

2. How did people preserve food before gas and electric cooling? Have students investigate the use of smoking, spicing, and drying food. Have them investigate the following statement: "If the Europeans had had refrigerators in the 1400s, America would not have been discovered." (This is a reference to the Europeans' search for spices at that time.)

Name:

Watching the Wash

The next time it's clothes-washing day at your house, find out the following: Before the clothes are washed, is the laundry sorted into different groups? How are the clothes piled? In what order are the piles of clothes washed? Why are they washed in this order? What types of clothing require hot water? What types of clothing can be washed in warm or cold water?

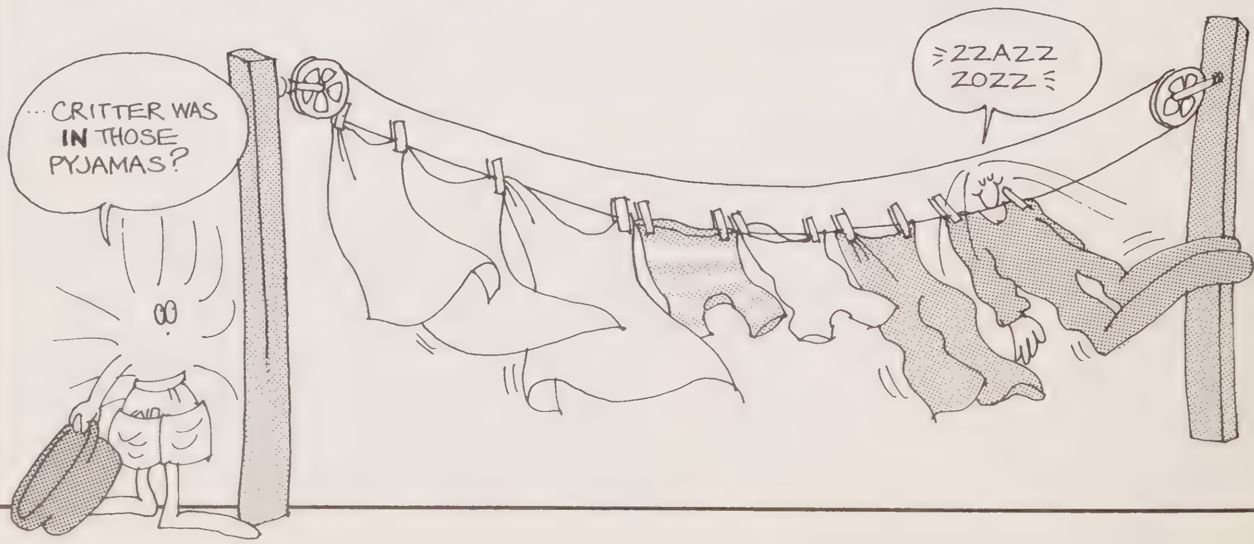
Draw a diagram of the controls of your washing machine.

1. What is the purpose of each dial?

2. How could the use of the washing machine be changed to save energy?

Drying the Clothes

After the clothes have been washed, how do we get the water out of them? How can the sun help? What items are best allowed to dry by hanging them up wet? After the clothes are dried, what happens to them? Why are some clothes ironed, while others are not?



Notes

This at-home activity is designed to help students focus on the care of clothing in the home and on the fact that we use appliances that consume both hot water and electricity. A great deal of energy is used to heat the water for home laundering. While drying clothes in an electric or gas clothes dryer may be convenient, there are alternatives that can conserve our energy and actually help clothes last longer.

Although most children may not yet be ready to take over the responsibility of washing and drying their own clothing, they should be aware of how clothes are cared for and of the energy that is used to keep their clothes clean. They can also influence their parents by suggesting energy-conservation methods connected with washing and drying clothes. The largest single contribution to energy conservation in the home could be realized by switching from hot- to cold-water washing cycles. The more wash done with cold water, the more energy saved. Rinses should always be with cold water if possible. Permanent-press clothing, washable woollens, and lightly soiled clothing can be washed in cold water. Cold-water detergents are now on the market that contain germicides which take the place of hot water in the killing of bacteria.

Drying clothes uses large amounts of electrical or gas energy if an automatic dryer is used. Children should be aware that some clothes dry wrinkle-free only when hung up to dry. A warm setting on the dryer should be used for lightweight clothes, and a hot setting for heavy ones. Air-drying clothes on a clothes line may seem old-fashioned and time-consuming, but it certainly saves energy. Sun-drying also has a germicidal effect, adds needed humidity in the winter, and makes linens smell fresher. Hanging clothes on a wooden clothes dryer in the basement in winter will get clothes dry, and the evaporated moisture will add humidity to the air.

If clothes are removed promptly from the dryer and folded or hung carefully, many articles will require little or no ironing. Hand irons can consume as much energy as ten 100 W light bulbs, so their proper use will conserve energy as well as preventing scorching or underpressing. Children should realize that many of our clothes are permanent press. Washers and dryers have permanent-press cycles which use low temperature settings and are specially designed to avoid wrinkling so no ironing is necessary.

Children should take home the activity sheet and observe how a washing is done. The amount of energy used in the washing, drying, and ironing of clothes is considerable. Have the pupils discuss how the cleaning of clothes can be done using natural energy sources such as the sun. The drawing of the dials on the washing machine should be discussed with the children in terms of the following questions: What is the purpose of each dial? What controls help save energy? How are they able to do this?

Table J3.1: Cleaning Chart

Follow the Signs

Manufacturers have been encouraged to use these symbols on labels attached to textile articles. By following the symbols you are assured that your garment will not shrink, stretch or change colour beyond acceptable limits. Care label information can help you choose textile articles by giving you an idea of the expense and time required to maintain a new purchase in good condition.

Washing	Do not wash	Hand wash in lukewarm water	Machine wash in lukewarm water at a gentle setting —reduced agitation	Machine wash in warm water at a gentle setting —reduced agitation	Machine wash in warm water at a normal setting	Machine wash in hot water at a normal setting
Chlorine Bleaching	Do not use chlorine bleach	Use chlorine bleach as directed				
Drying	Dry flat	Tumble dry low temperature	Tumble dry medium to high temperature	Hang to dry	Drip dry	
Ironing	Do not iron	Iron at low setting	Iron at medium setting	Iron at high setting		
Dry Cleaning	Do not dry clean	Dry clean — tumble dry at low temperature	Dry clean			

Consumer and Corporate Affairs Canada
Consommation et Corporations Canada

Follow-up Activities

1. Have children investigate the labels on their clothes. Cleaning instructions are now mandatory. Have them discuss what is meant by bleaching and dry cleaning. Ask them why these instructions are attached to the label.

2. Have children investigate static electricity and its effect on their clothes. During the winter months static electricity in synthetics makes clothes cling. Students may be asked the following questions: How can we get rid of static electricity in clothing? (By using a fabric softener in the final rinse.) What is static electricity? Have the children perform some simple classroom investigations involving static electricity (e.g., have them rub their feet on a mat and touch the door knob).

3. Have children investigate detergents. A consumer-study project can be developed comparing brands and their prices to enable students to answer such questions as the following: Which gives the best value per gram? Which produces the most suds? Which can be used in hot as well as cold water? Are special cleaners and soaps required for certain articles of clothing? Why is this necessary? What is meant by "biodegradable" when we talk about detergents?

4. Visit a dry-cleaning store. Students might be asked to answer such questions as the following: What is meant by the term "dry cleaning"? Is it really dry? Why do people take their clothes to a commercial dry cleaner? What machines are used in such a store? How much energy is used to clean, dry, and iron the clothing?

5. Have each child bring one item of clothing from home and one clothes hanger. Have a clothes-hanging race. Put the clothes in a pile and divide the class into four relay teams. The object of the game is to hang all the articles in the pile on the hangers. Children may hang up any article they choose. To make it more difficult, have them find their own item and hang it up.

Related Ideas

1. In a craft program, children may make and decorate their own cloth laundry bag. With parental permission, some of the children may wish to tie-dye T-shirts, or use silk-screening or felt pens to decorate their clothing.

2. Sorting activities can be developed from activity 5. above. The children could take turns sorting the clothing by categories such as light and dark colours, heavyweight and lightweight articles, permanent-press and regular articles, and according to the different types of materials.

3. Using the library, students can research the cleaning of clothes in Canada since pioneer times. Ask students the following questions: How did the pioneers get their clothes clean? How was soap made? What were washing machines like before today's automatic washers?

Name:

Getting Heat From Snow

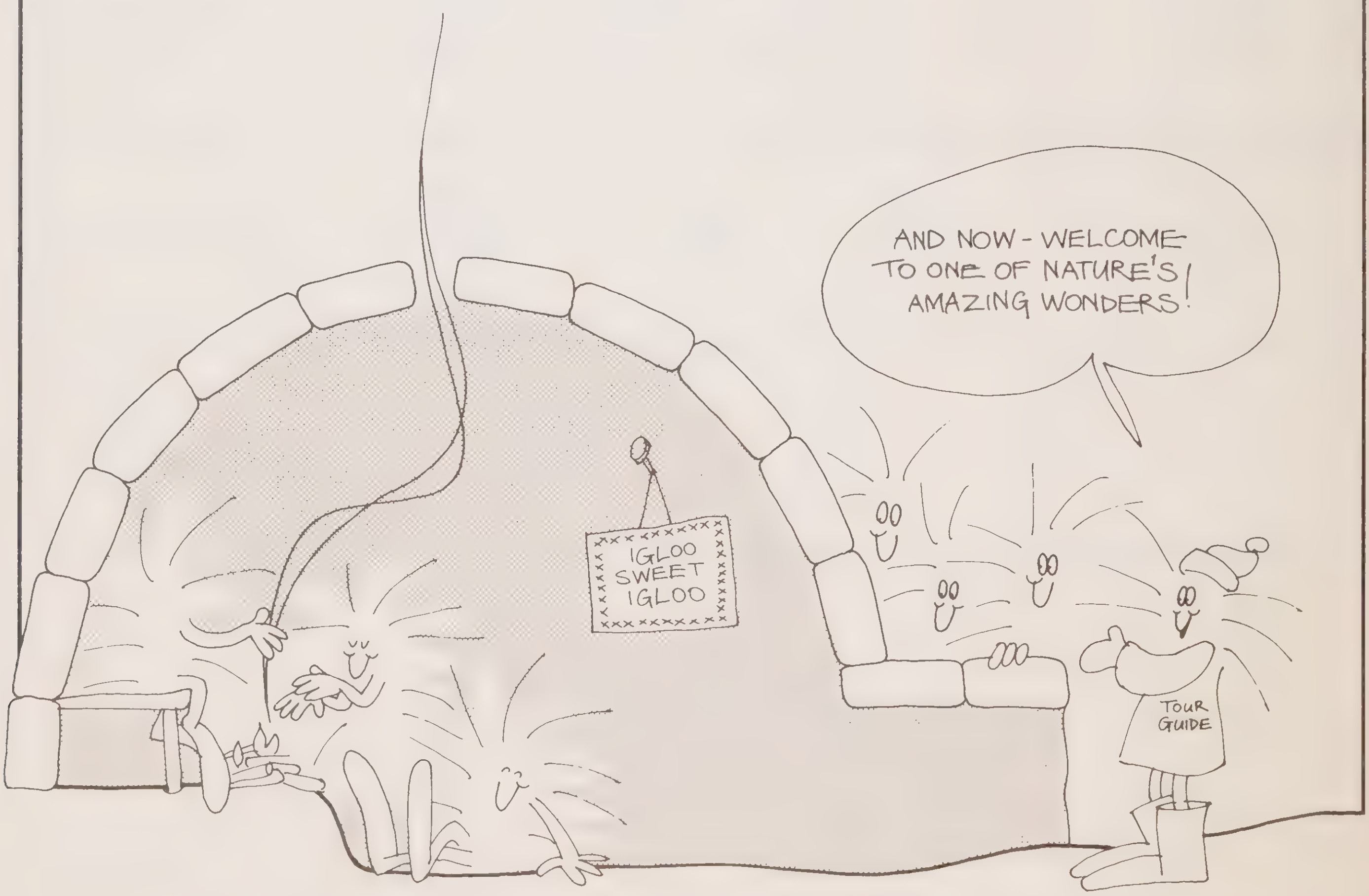
The next time it snows heavily, go outside and find a fresh bank of snow. Using a thermometer:

1. take the air temperature (about 50 cm above the ground);
2. take the temperature of the snow surface;
3. take the temperature about 15 cm below the snow's surface.

Record your results:

Temperature above snow surface	
Temperature at snow surface	
Temperature below snow surface	

1. Where was the temperature the highest?
2. Why is there such a difference in the temperature readings?
3. People have made use of this knowledge for a long time. Give some examples of the ways in which people have used the insulating property of snow to protect themselves.



Notes

The purpose of this activity is to introduce students to a series of winter investigations relating snow to energy usage. In the student activity, children explore the insulating qualities of snow and how heat energy can be trapped in the pockets of air that surround the snowflakes on the ground. Other snow activities focus on the use of snow for keeping heat from escaping (igloos, animals' homes, snow shelters). Students can also learn how to determine where heat is escaping from their homes or school by examining the pattern of melting snow. This may be related to the conservation of energy and how we can keep the heat where we want it to be.

Newly fallen snow is one of the best insulating materials in the world. Because fresh snow is mainly air, tiny air pockets around each snowflake keep heat in or out. The student activity of testing the temperature of the snow and air at different levels should reveal that the temperature of the air and of the snow surface are much lower than the temperature below the snow surface. This is particularly noticeable if the day is very cold.

Due to the radiation and evaporation caused by the sun, the top of a clean snow surface is subject to almost continuous heat loss. The surface becomes particularly cold on clear winter nights. Even on sunny days, the presence of snow results in lower air temperatures than if the ground were bare. The crust of the snow can never rise above 0°C, which means that the snow cannot warm, to any extent, the layer of air it is in contact with.

On the other hand, because the soil underneath is protected by its snow cover from losing heat through radiation, its temperature remains fairly constant, usually somewhere just below the freezing point of water.

The Inuit have long understood this principle of the insulating effect of snow. Their igloos, now replaced by tents and wood-frame homes, used the snow-block concept for keeping in the heat. The inside of a well-made igloo could be maintained at a comfortable +16°C with the aid of a small fire and the body heat of the occupants, despite the fact that the outside temperature might be −45°C.

Animals use the snow for winter homes too. Burrowed into the snow, they are kept warm by their body heat during winter nights, thanks to the insulating quality of the snow. Humans use the same idea when they build snow shelters while camping.

As well as keeping the heat in, snow will also absorb heat. When heat is escaping from a building or from the ground, the snow will melt, evaporating into the air. By studying homes and the school, children should see the sections of a home where the snow melts the quickest. They should see that the longer snow stays on the roof, the more heat is being retained. The presence of snow also shows that interior insulation is keeping home heat inside the building. A study of homes and snow could also be used to determine whether darker- and lighter-coloured roofs have the same amount of snow on them. (See Activity Set 8: Choosing Colours Carefully.)

The activities on the student activity sheet are easy to do when there is sufficient snow accumulated to dig into snow banks to a depth of 20 cm. The colder the air temperature, the more dramatic will be the temperature difference. The children can repeat the investigation on sunny or cold days to note any differences in the results. If they can dig into the ground, they may wish to take ground-temperature readings as well so as to further compare temperature differences. They should work in groups, and can keep an ongoing record of the temperature differences.

Follow-up Activities

1. Have the children watch the snow on the roofs of houses in the winter, and consider the following questions: From which roofs does the snow melt the quickest? In what direction does the roof from which the snow melts the quickest face? Does the colour of the roof affect the melting of the snow? Does the snow melt from certain coloured roofs quicker than from others? Does the snow melt from all parts of the roof evenly? Why doesn't it? Why is it better for the snow to remain on the roof for a longer period of time than for a shorter period? How does it save fuel?

Have students draw diagrams of their own roofs several days after a snowfall. Ask them what information these diagrams give them about the insulation in their homes.

2. Have students study stories about people trapped under heavy snow and try to answer the following questions: How did they manage to survive? How did the snow turn out to be useful to them? Why can people trapped in avalanches remain alive for long periods of time?

Related Ideas

1. Have children use the library to find out the ways in which animals adapt to snow conditions and then answer the following questions: How does snow help animals to hibernate? How have other animals adapted to living in and on the snow? (colour, hair, snowshoe-like feet)

2. Ask students the following questions: How have people adapted to snow conditions? (snowmobiles, snowshoes, snow tires, snowploughs, and salt on the road) Which of these require energy from fuels? What alternatives do we have if the fuels are used up? (For example, skis and snowshoes can replace snowmobiles.)

3. The Inuit are masters at surviving in snow conditions. Ask the students what other uses, besides the igloo, the Inuit have made of snow to help them survive in the North. Have the children find stories of how the Native people used snow to their advantage.

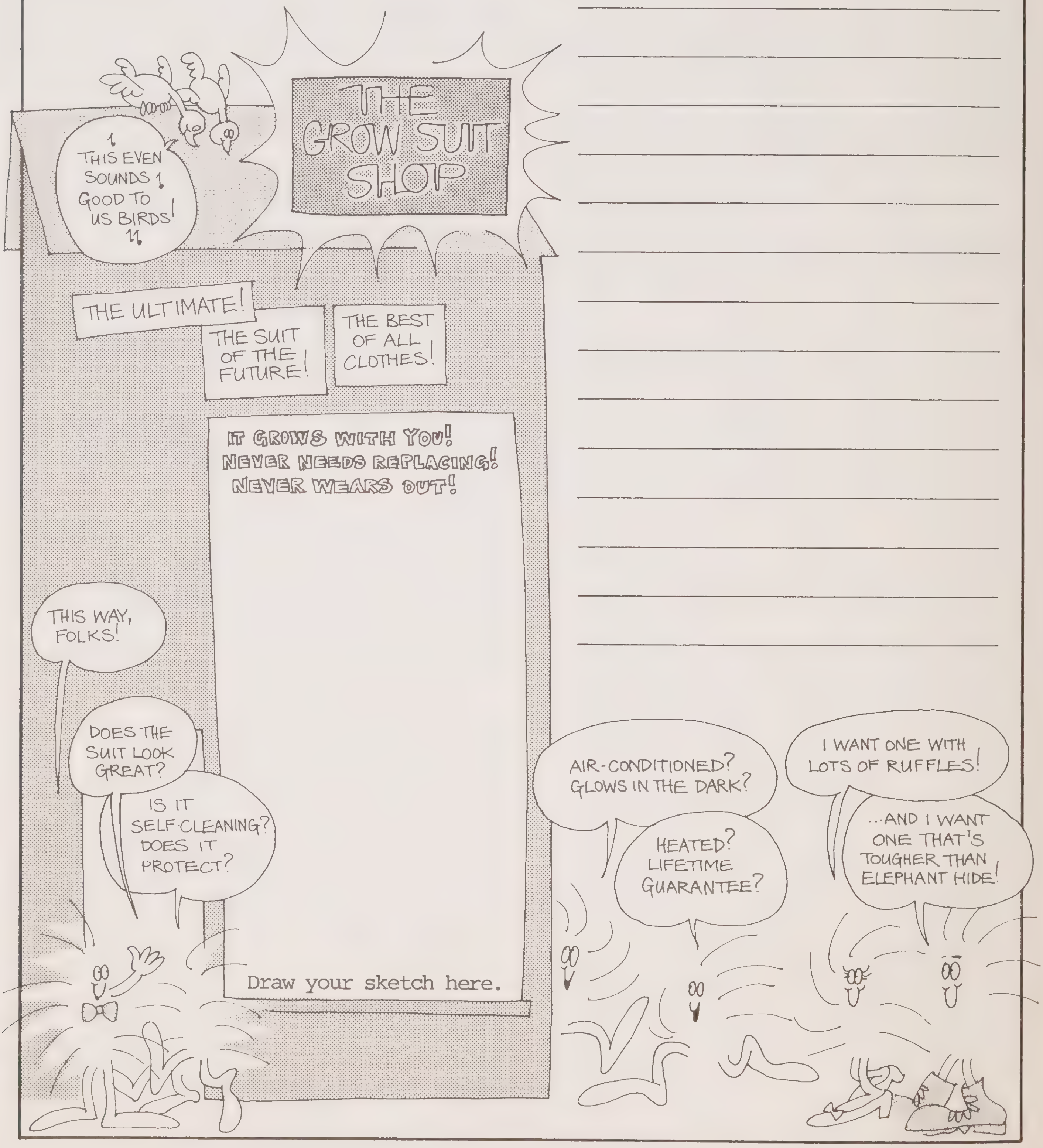
4. Have students answer the following questions on snowfall in Canada, using an atlas with maps containing snowfall and temperature bars: How much snow falls on your area? (Use a snowfall map to find out.) Why are there such big differences in the amounts of snowfall on sections of the east and west coasts? What areas in Canada get the most snowfall? What areas get the least? What relationship is there between the amount of snowfall and the average temperature of an area?

Name:

18

The Grow Suit

Invent a grow suit - a suit that grows with you. Draw a sketch of it. Explain the features that would make it the best clothing ever invented.



Notes

This activity provides the student with the opportunity to design the ultimate in future clothing – a suit that can be worn for a person's lifetime and never needs replacing. Future clothing styles and the need to consider fabric changes can also be discussed with particular reference to our declining petroleum supplies – the basis of much of our present synthetic-fibre industry.

The world of fashion changes from season to season, and from year to year. Colours, styles, and fabrics combine to excite people into buying new wardrobes even when the clothes they are wearing are still suitable. Keeping people clothed fashionably involves many large industries, which require large amounts of electrical power to run the machinery necessary to produce cloth and clothing.

Much of the cloth presently being produced is synthetic. In 1977, for instance, synthetic fibres accounted for 4 037.0 million kg of total world fibre production; cotton accounted for 1 437.8 million kg; wool for 60.7 million kg; and silk for 0.6 million kg, according to *Modern Textiles*, vol. 59 (New York: Rayon Publishing Company, May 1978), p. 8.

Natural animal and plant fibres continue to be used, but their production is on the decline. Much of this decline is due to the fact that synthetic fibres have lower production costs. But synthetic fibres present a significant problem in a world that faces an energy shortage. These fibres are largely being developed and produced by the chemical industry, which is dependent on coal, petroleum, and natural gas for its raw materials. If we are faced with a shortage of these resources, or if the cost continues to rise significantly, many types of cloth from which our clothes are presently being made will disappear. The world of plastics will also disappear, and items such as plastic raincoats will no longer exist.

New types of clothing, such as inexpensive, disposable clothing made from paper and expensive, fire-retardant clothing made from asbestos, have been tried in the past. The search continues for new types of fabrics to meet our needs – strong, long-lasting children's play clothes (jeans) that can be easily washed and adult clothing that sheds wrinkles, doesn't cling, and is colourfast.

Children can be helped to realize that large amounts of electrical energy are required to power the machinery needed for making the fabrics and then turning them into clothes. The proper use of clothing will help conserve energy, because we will not need to buy as much as often. Clothing can be repaired or mended rather than thrown out. If clothes are to be discarded, they may still be in satisfactory condition for others to use them. They may be given to a local charity which could distribute them to help others. Old clothing can also be used as rags for clean-up jobs around the house. Children should also be exposed to such ideas as not replacing a wardrobe every year simply because a designer says it is time for a new look, or because a movie star or rock singer creates new fashion trends.

The student activity focuses on the development of the "ultimate" piece of clothing. The children are asked to draw and elaborate on the features of their grow suit. Have the students explain how the suit will grow and what type of energy could be used to keep it air-conditioned or heated. Ask them if they would really want to have something like this or whether they would prefer a variety of different clothes.

Some people would argue that the ultimate "grow suit" has been with us since we were born. Although it does not glow in the dark and it does develop wrinkles, our skin has many exciting features. It has its own heating and cooling system. It can replace itself, is easily cleaned, protects the body, and, ideally, looks great. It is tough and strong, and you can wash and wear it. It also comes with a lifetime guarantee.

Children will enjoy using their skin as the focus for a jargon-filled advertising campaign as suggested here. It is also important for them to remember that the clothes we wear and the shelters we live in are simple extensions of our skin: they are our means of protecting and maintaining our bodies.

Follow-up Activities

1. Have students make a collection of the different types of fibres used in clothing manufacturing. Have the materials grouped into synthetic and natural fibres. Ask students questions such as the following: What is the origin of the material? How is the cloth eventually produced? How does it get its colour? What are the main features of each type of material?

2. Have students develop a test for the durability of different types of fabric. One such test would be to rub different fabrics with a steel-wire brush until they are worn through. The number of rubs required may be counted, and the students could determine how this information can help save energy.

3. Have the children investigate ways in which old clothing can be recycled or reused (e.g., nylon stockings can be used to stuff toys and cushions, or to tie up newspaper bundles). Children may explore the "lost-and-found" box at school to find out what types of clothing seem to get lost (or found) the most. They can focus on such questions as the following: Are the items really lost or just forgotten? Why aren't all the items claimed? What does the school do with the articles that are not claimed? What can students do so that lost clothes could be returned to the owner more easily? How does the "lost-and-found" box show that energy is being wasted?

Related Ideas

1. Have the children visit a clothing store to talk to the owner about the value of different fabrics and what types of cloth people wish to buy. They can determine whether the store's customers consider fashion or practicality first, and whether and for what reasons a label such as the accompanying one helps sales.

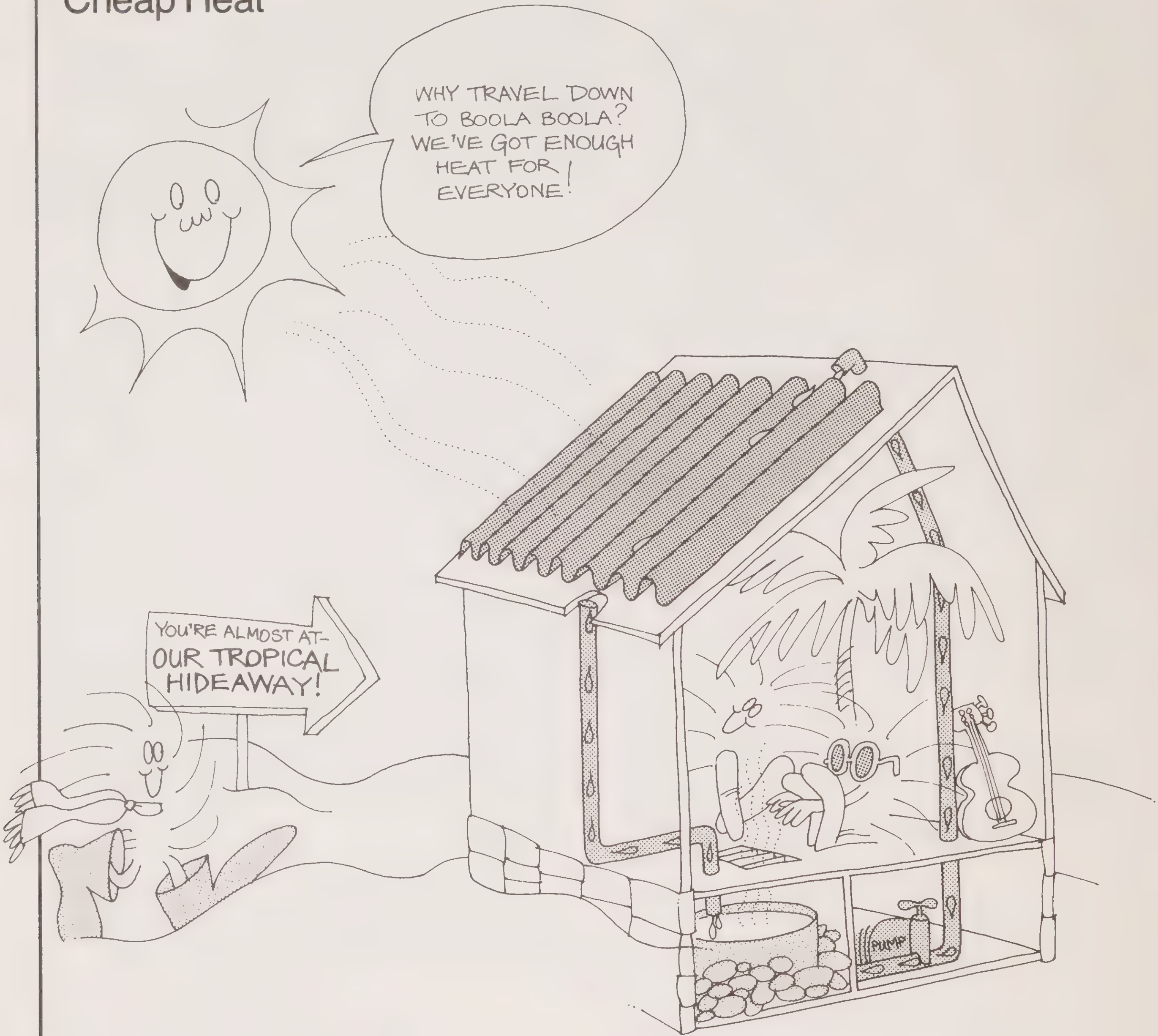
2. The world of synthetic fibres has produced many new words, which can be added to the children's spelling lists (e.g., nylon, acetate, rayon, acrylic, polyester, lycra).

3. Ask students what materials we might be able to use that we are not already using to provide us with clothing, if the world could no longer produce synthetic fibres using petroleum or natural gas.

4. Have students investigate "clothing" that grows. For example, the fur skins of animals and the skins of plants (e.g., tree bark) serve many functions. Have the children make a list of living grow suits and how they are used.

Name:

Cheap Heat



People are learning to use the heat from the sun to heat their homes, water, and swimming pools. Even during the winter, the sun can heat water or air to warm our houses.

Trace the energy from the sun to see how it heats this home.

1. Where is the sun's heat collected?
2. Where is the heat stored?
3. How is the heat distributed to the room?
4. How can we control the amount of heat distributed to the room?
5. What happens at night or on a cloudy day?

Cheap Heat

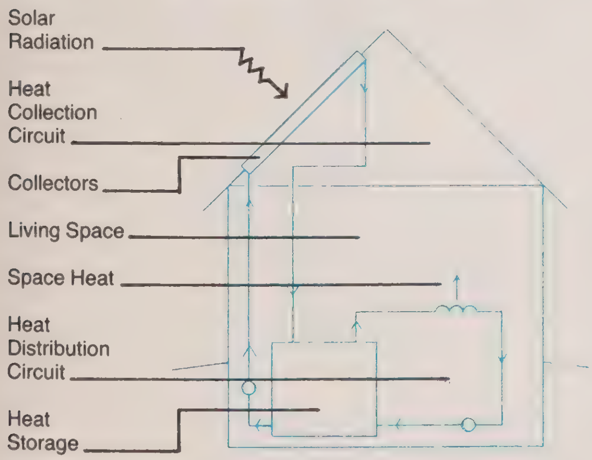
Notes

Although there are still many problems to be answered regarding the uses of solar energy, students should study and appreciate the future of this inexhaustible energy source. This activity introduces students to the concept of solar energy and how it is converted into usable heat energy for the home.

The electromagnetic radiation from the sun is the earth's major energy source. Without it, life on earth would be impossible. As our non-renewable fuels dwindle, ways are being developed to harness this solar energy, as the following passage explains.

> **Solar Energy for Space Heating**
> The sun's radiation can be used to heat homes in much the same way as conventional heating systems do it now. An essential prerequisite for economic solar space heating, however, is a well insulated structure.
>
> **Basics of Solar Heating**
> In general, solar heating consists of several steps:
> **Collecting the energy:* with a bank of dark, energy absorbing panels or collectors designed and oriented to trap solar radiation and often located on a rooftop. The heat produced is carried by a fluid such as water, glycol or air circulated through the collectors;
> **Storing the heat:* heated water can be stored in an insulated tank while heated air can be transferred to a bed of rocks, both usually located in a basement;
>
> **Distributing the heat:* the heated air or water from the collectors or heat storage is circulated throughout the area to be heated;
>
> **Controlling the system:* pumps, valves and automatic controls are used to collect and distribute the solar heat. . . .
>
> Most of the components of a solar heating system, except the collectors and storage equipment, are standard heating and plumbing items.

Figure J1.1: Components of a solar heating system.



Source: Adapted from Energy, Mines and Resources Canada, *Solar Heating in Canada* (Ottawa: Publishing Centre, Supply and Services Canada, 1978), p. 2.

From the drawing of the solar-heated home, students can see the basic components of the system. The questions are designed to have them investigate how the sun's energy is collected by the water running over the solar panels, the heat produced being stored in the underground tank and circulated by the air throughout the house. The valve is used to stop the water flow, shutting off the system.

The problems of providing heat at nighttime and on cloudy days are still to be answered, but systems have now been developed that have the ability to store summer solar energy as heat and to deliver it in winter.

Follow-up Activities

1. Which materials store solar energy the best? To answer this question, have the students paint a cardboard box black and put four small metal cans into it. The first can is filled with sand, the second with water, and the third with torn-up paper. The fourth is already filled with air. The closed box is placed in the sun for one-half hour, after which the cans are removed. A thermometer is placed in each can, and the students watch the temperatures fall in order to answer the following questions: After 15 min which material showed the least drop? Which stores the heat produced by the sun the best? How could this information help if you were designing a solar heating system?

2. Have the students construct a solar water heating system. A model can be made or a system actually developed by using a plastic garden hose. This can be done in the schoolyard. The hose is coiled across a large sheet of aluminum foil and covered with clear plastic or glass (to let the energy in but prevent it from escaping). The temperature of the water at the tap is recorded, and then water is run through the hose until the hose is filled. The water is allowed to remain in the hose for 1 h on a sunny day. The temperature of the water in the hose is then taken by letting the water out the nozzle into a container. The difference between the two recorded temperatures of the water is then calculated. Ask your students how they could increase the efficiency of the system.

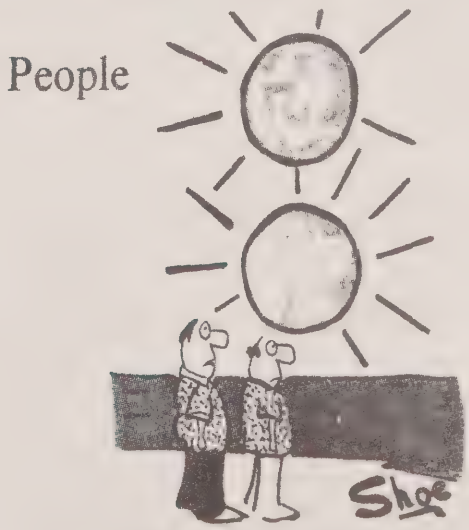
3. Have students design a method of solar-heating a home swimming pool. (The easiest way is to simply cover the pool with a clear plastic sheet.)

Related Ideas

1. Have students find all the articles they can regarding solar-heat development for one week. As well as newspaper articles, magazines such as *Popular Science* and *Popular Mechanics* have regular features regarding solar energy and alternative energy sources.

2. Have students prepare a report on the different types of solar heating systems, stating the advantages and disadvantages of each. Initial cost, operating efficiency, and energy storage features are all important factors to consider.

3. Have students design a future city based entirely on solar energy. The light energy from the sun can be used to generate electricity by using photo-electric cells. Have students investigate this means of electrical energy development for their city. The sun's energy is used to grow food and to give us light and heat. How else could it be used in this city?



"This should make the solar energy people happy!"

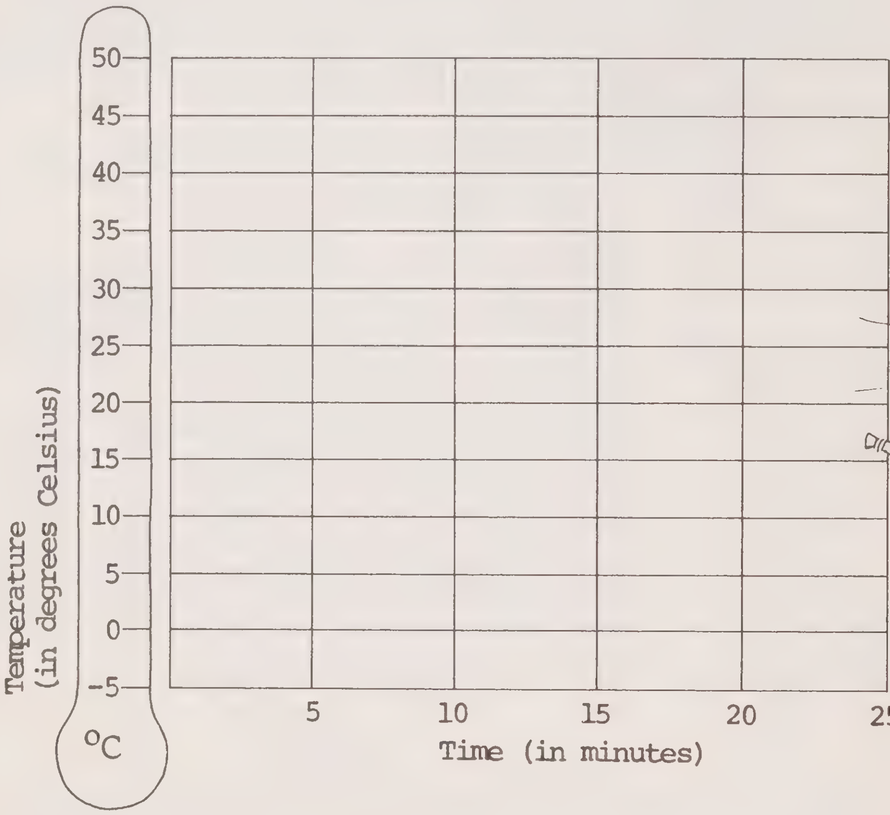
Name:

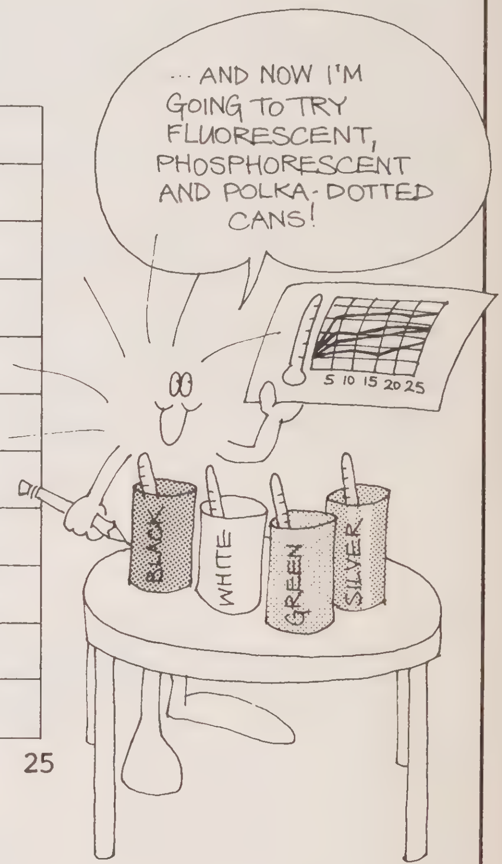
Choosing Colours Carefully

Did you ever stop to think about the colours of your clothing? They can often affect the way you feel, particularly on warm or very cold days. Let's find out why.

You will need four empty soup or juice cans. Remove the paper labels. Using poster paint or felt pens, choose three very different colours and paint the outside of each can. Leave one uncoloured. Fill each can half full of water and place it in the sun. Add a thermometer to each and measure the temperature every 5 min for 25 min.

Make a graph of the results:





1. Which colour showed the fastest temperature increase? We say that this colour is a good absorber of radiation, because it absorbs the sun's energy quickly.

2. Which colour was a poor absorber of energy?

3. Test other colours. Is black a better absorber than white? Is red better than blue? Green better than orange?

4. What would be the best colours to wear in very warm weather?

5. What colours would be best to wear in cold weather?

Choosing Colours Carefully

Notes

This activity will show students that different-coloured collectors will convert solar energy into heat energy at different rates. Colour plays an important role in determining the quantity of radiant energy that is absorbed by a substance and converted to heat energy.

A knowledge of how colour affects heat absorption is very important to architects, cloth designers, and to children and their families. It is a factor in our choice of colour in the clothes we wear and in how our homes and automobiles should be painted.

Electromagnetic radiation carries energy in all directions throughout the universe. Light is one form of this energy that stimulates our sense of sight. Heat (infrared waves) is another form of energy. We see different frequencies of light waves as colour. White is a mixture of all the light frequencies; black is the absence of light.

Colours differ in their ability to absorb this radiant energy. Generally, the lighter or whiter the colour, the better its ability to reflect light and heat. The darker the colour, the less light it can reflect, and the better it can absorb the radiation that falls on it.

Colour dyes used in clothing, ink, and paint have the ability to absorb and reflect heat radiation. Different colours differ in their ability to allow heat to be absorbed by the dyed material. The more heat absorbed, the greater the transference of heat to the object surrounded by the coloured material.

Generally, the lower the electromagnetic wave frequency, the higher the rate of heat absorbency. This means that a person would feel warmer if he or she were wearing red clothing rather than blue clothing of the same material and design.

This knowledge becomes important in lifestyle decisions because the colour of the roof and walls of a house or the colour of the clothes we wear can be very important in determining the amount of heat the item will absorb. The more heat required to keep us warm, the more energy will be needed to produce it. Conversely, the more air conditioning needed to cool a person, the more energy consumed. Choosing colours carefully can help conserve energy.

Follow-up Activities

1. Have students try the following experiment. Have them lay sheets of different coloured construction paper on the snow on a sunny day. After several hours, they should return and measure the depth to which each coloured paper has sunk in the snow. The paper that is deepest has absorbed the most radiation, causing the snow beneath it to melt most quickly. Ask students which colours are the best heat absorbers. Tempera paint, sprinkled on the snow, will have the same effect.

The following chart lists the radiation frequencies and wavelengths associated with the colours of the visible spectrum. When radiation is absorbed, it is converted to random vibrations of the atoms and molecules of the absorbing material. This random motion we call "heat energy". Note that in the chart, the radiation frequency rises as the colour intensity darkens, and conversely the electromagnetic wavelength drops.

Pure Colour	Frequency (in waves per second)	Wavelength (in centimetres)
Red	4.6×10^{14}	6.5×10^{-5}
Orange	5.0×10^{14}	6.0×10^{-5}
Yellow	5.2×10^{14}	5.8×10^{-5}
Green	5.8×10^{14}	5.2×10^{-5}
Blue	6.4×10^{14}	4.7×10^{-5}
Indigo	6.8×10^{14}	4.4×10^{-5}
Violet	7.3×10^{14}	4.1×10^{-5}

Source: Louis T. Cox. National Science Teachers' Association, *Energy in Waves* (Darien, Conn.: Teachers' Publishing Corp., 1964), p. 73.

2. Place a thermometer in the sunlight and cover the thermometer bulb with a 3 cm² sheet of construction paper. Measure the number of seconds required for the temperature to rise 3°C. Record the time. Repeat the activity using different-coloured paper. (The rise in the thermometer is caused by the heat produced in the coloured paper by the heat radiation it absorbed from the sun.)

3. Have students explore the question "Which colour holds heat the longest?" by trying the following activity: Using four juice cans painted white, black, green, and red, they fill each with the same amount of hot water. A thermometer is put in each can and the temperature recorded every 5 min until the water cools to room temperature. The following questions should now be answered: Which colour held heat the best? Is this the same colour that absorbed heat the best?

Related Ideas

1. Have your students explore the ways in which colour affects language use. For example, what do people mean when they say, "That's a warm colour to use to paint your room"?

2. Invite an artist to visit the classroom to discuss with your students how he or she uses colour to create warm or cold feelings.

3. Have your students decide which colour or colours are best for an automobile in your part of Ontario. They can then draw a picture of a car of the future using these colours.

4. Invite an architect or clothes designer to visit the classroom to tell your students how he or she uses colour in his or her work. The guest can be asked whether a specific colour is used for energy-conservation reasons or because it looks nice.

5. Ask your students what information about colour they would need before they chose the colour of the paint for their bedroom walls.

6. Have your students explore the relationship between colours and light. Have them look at different-coloured sheets of paper or material under lights covered by coloured cellophane. Have them find out what happens when you match cellophane and paper of the same colour. See if they can create new colours by mixing the colours of cellophane and paper.

7. Have your students use a prism to explore the light spectrum of sunlight. (Each colour in the beam of light is bent differently as it passes through the glass, causing the different colours to separate.)

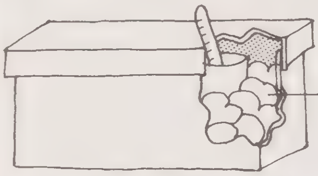
8. Have your students explore the idea that most plants are green: that is, that life on our planet can be associated with green plants, which produce food and oxygen. Ask them which plants have no green in them and how these plants live and grow.

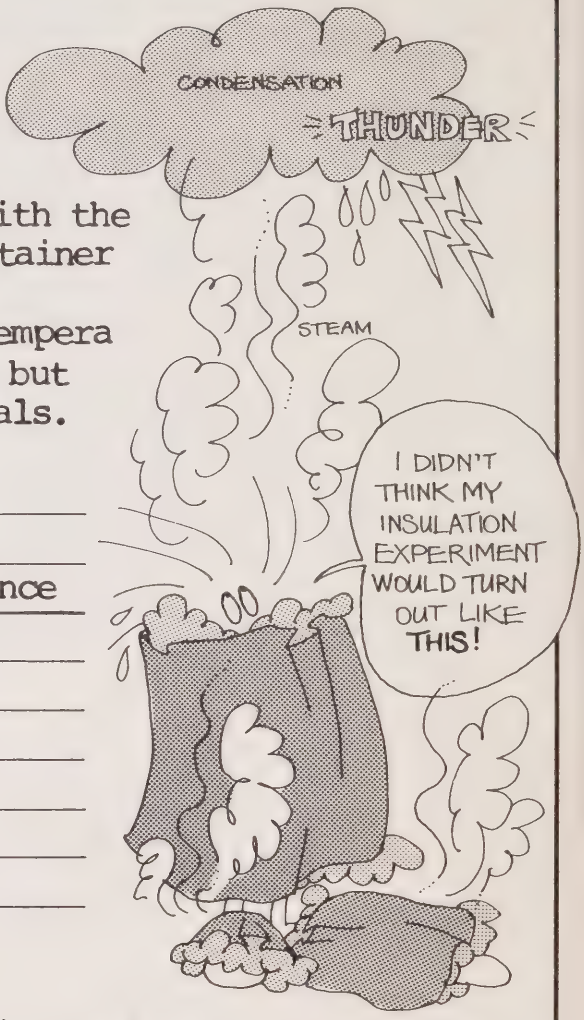
Name:

Keeping the Heat In

Heating our homes and schools is very expensive. It also consumes large amounts of energy. How can we keep the heat in our homes once it is there?

Here's an activity to help you find out. You'll need a shoebox, a container of hot water, and a thermometer. You should also have lots of materials such as cloth, newspaper, wood shavings, cotton balls, and styrofoam.





Set up your box as shown above. Start with the box filled only with air. Place the container of hot water in the box and record the temperature. After 10 min, record the tempera ture again. Start again with hot water, but insulate the box with one of the materials. Record your results on this chart.

Materials	Temperature		
	Before	After	Difference
Air			
Cloth			
Newspaper			
Fibreglass			
Cotton			
Aluminum foil			

Some things to think about:

1. Which material helped keep the heat in the best?
2. Why should we insulate our homes?
3. How is your home insulated? How is the school insulated?
4. Is good insulation only important in the winter when fuel is being used to heat a building? Explain.
5. How can we keep the heat around our bodies on cold days?
6. What type of people insulation works the best? Design an activity to test your belief.

Notes

In this activity the students will compare the heat loss in an insulated container with that of a non-insulated container. They will also compare the rate of heat loss using different types of insulating materials.

> The moment heat is generated it tries to escape into the colder outside air. In a building it vanishes through the ceiling, disappears through walls and pushes outside around cracks and openings in windows and doors. The rate at which heat escapes depends upon the resistance it meets and upon the difference between the outside and inside temperatures. Insulation forms a tough resistance barrier to trap the heat and keep it inside . . . where it belongs. In many cases adequate insulation can reduce the size of the heating system installed in a new home – and offer savings of up to 30% on the yearly heating cost of an existing house.

Source: Ontario Hydro, *Insulating Your Home* (Toronto: Ontario Hydro, 1976), p. 1.

SEASONAL HEAT LOSS FROM TYPICAL HOUSE

Source: Ontario, Ministry of Energy, *Turn on the Sun* (Toronto: Ministry of Energy, Ontario, 1977), p. 17.

The ability to "keep the heat in" depends on a material's capacity to resist heat flow. Commercial insulation and building materials are measured by their resistance value. The following chart shows the "R value" of some common building materials. The higher the resistance value, the less heat will escape, thus making the material a better insulator.

Table J3.3: Insulation Materials and R Values

Type of Material	Thickness (in cm)	R Value
Loose-fill		
Cellulose fibre	1	1.5
Mineral fibres	1	1.2
Vermiculite	1	0.9
Batt-type		
Fibreglass or rock wool	1	1.3
Expanded polystyrene ("Beadboard")	1	1.5
Styrofoam	1	1.3
Polyurethane	1	2.3

The children, working in pairs, should complete the insulation activity and be prepared to discuss the "Some things to think about" section. They should be helped to realize that insulation works in two ways: in winter it keeps the heat inside the house; in summer it keeps the heat outside. (See Activity Set 4.) Children should also see that the materials we wear act as insulators. Different materials have different resistance value. As well, the way we dress can affect the insulation qualities of our clothing. The layered look in winter helps trap body heat in the air spaces, thus helping us keep warm with a minimum use of energy.

It is not necessary for the children to concern themselves with the "R value" of materials; what is important is that they realize that some materials help keep heat where it is instead of allowing it to move.

The water used in the activity should not be boiling hot, but it should be hot enough to allow a drop in temperature to take place over 10 min.

Although air will appear on the chart as having little insulative value whatsoever, it is important to realize that dead air trapped in snow, clothing materials, or in walls can act as a very valuable insulator.

Follow-up Activities

1. Have your students determine the adequacy of the wall insulation in their homes. On a cold day, when the heating system is operating, tell the students to place a thermometer firmly against the inside surface of an exterior wall of the house. They should allow time for the thermometer to register, and then take a second reading in the middle of the room. The two readings are recorded. If the difference between them is greater than 2°C, the wall is probably not adequately insulated. Try this exercise in your classroom.

2. Have your students make a study of the things in the home or school that produce heat that we really don't want, especially in the summer. They will discover that light bulbs, refrigerators and freezers, older radios and television sets, and the outsides of ovens all do this. Can they think of ways of "keeping the heat in" on these items? (In many cases new technology has already done this, e.g., in the case of microwave ovens, transistor radios, fluorescent lighting.)

3. Have the children test different types of clothing materials using the shoebox activity. Have them identify which materials are the best people insulators.

4. Have the children test various types of containers to discover their insulative abilities. They can start with a thermos bottle, a glass jar, and a styrofoam cup. Each container is filled with the same amount of hot water. The temperature of each is measured and recorded, and checked again in a half hour to find out which is the hottest. The activity is then repeated with each container sealed and wrapped in newspaper or cloth. Do your students still get the same results?

Related Ideas

1. Have your students visit a building supply centre to see what materials are used in home building. Samples of different insulating materials can be collected.

2. Take your class on a visit to a construction site. Ask the builder to talk about the insulating materials being used and the regulations that set out insulation requirements in Ontario.

3. Have the children find other ways through which heat is lost from a home, besides poor insulation.

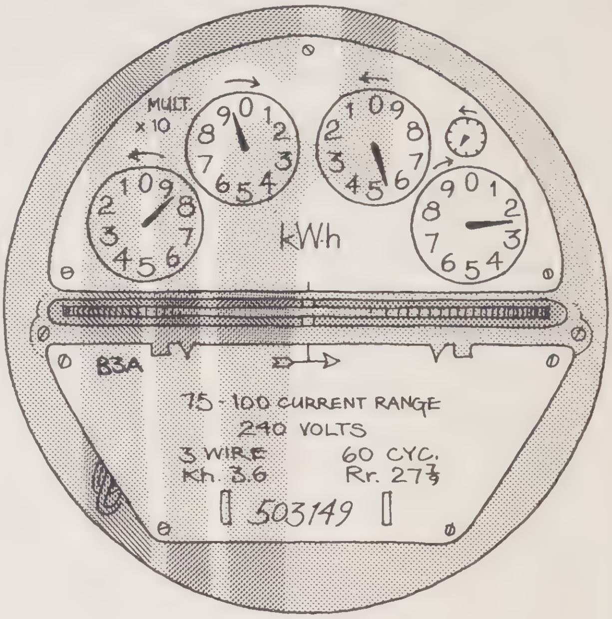
4. Have your class conduct a study of how each child's home is heated. The study should state what fuel is used to provide the heat energy and how the heat reaches the rooms of the house. Have your students make a graph to show the results.

Name:

Meter Readers (Part 1)

Most homes are filled with measuring devices which tell us how much energy we are using. These machines are called meters. One of these meters tells you how much electricity your home uses.

The meter shown here has a reading of 8952 kW·h (kilowatt hours). A kilowatt hour is an amount of electrical energy equal to 1 kW supplied for 1 h.



By reading your home electric meter for one week, you can find out how much electricity your family uses. Record the reading shown on your home's meter on the chart on this page. You should record the digit that the pointer has just passed.

1. How many kilowatt hours did your family use in one week?

____

2. How many kilowatt hours did you use per day?

____

3. On what day(s) did your family use the most electrical energy?

____

4. What might have been the reason for this?

____

____

Have a special energy-saving day at your house. Remember all your energy-saving rules. By using the electric meter, find out how much less electricity you used on the special day than you use on an average day.

Our Home's Use of Electricity

					Daily Energy Used (kW·h)
Start					
Day 1					
Day 2					
Day 3					
Day 4					
Day 5					
Day 6					
Day 7					
Total energy used for the week (kW·h)					

Source: Adapted from Ontario Hydro, Worth Watching (Toronto: Ontario Hydro, 1977).

Name:

Meter Readers (Part 2)

A gas meter measures natural gas in cubic feet. Locate your home's gas meter (if your home uses gas). The gas meter is read in the same way as an electrical meter. If your home has natural gas, find out how much gas is used in 24 h.

1. Record the reading of the meter: ______________________________

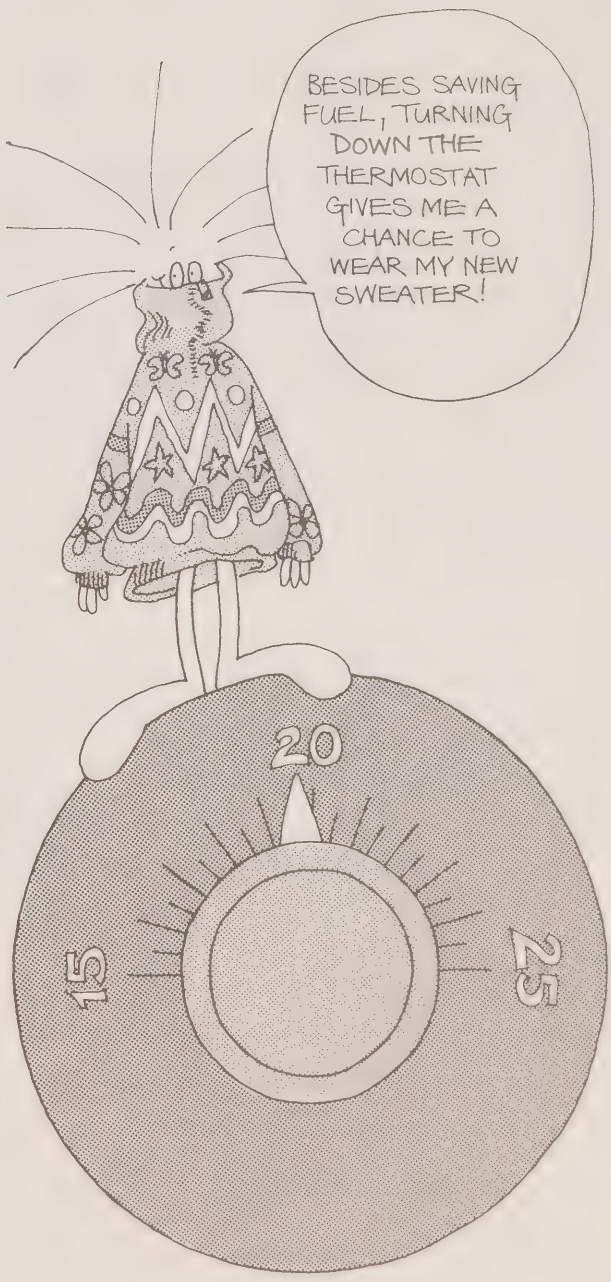
2. Record the reading 24 h later: ______________________________

3. Number of cubic feet of gas used (multiply by 100): ____________

Some homes use natural gas for heating. Other homes use oil. If your home uses oil, do you have an oil meter? _______ If your home uses oil, follow the method outlined above for natural gas to find out how much fuel is used. If you did not have a meter, how could you find out how much oil is used?

How could your family save natural gas or other heating fuel in your home? Here is one way. This is a thermostat. You'll find one on one of the walls of your house. What is it used for?

____



If you set it for 2°C lower than it presently is, you'll be helping to save a great deal of energy. Try it and find out how your family feels about lowering the temperature.

Does your home have other meters? What can you learn from reading them?

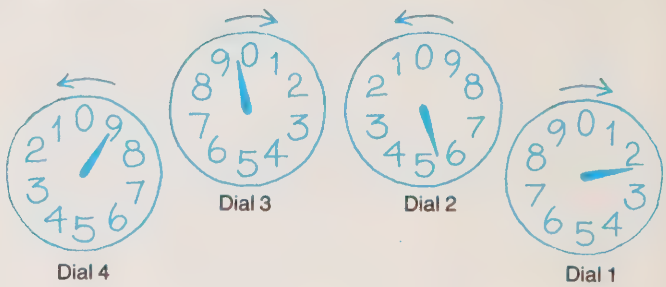
Notes

In this activity the students will learn how to read a meter that measures their homes' energy input. By being able to read the electrical, gas, or oil meter, the students can measure some of the energy that flows into their homes and demonstrate the effects of conservation methods on energy usage. The thermostat is introduced as one of the more dramatic means by which home energy consumption can be reduced without causing serious hardship.

People are concerned about the amount of energy used in their homes. Children should be aware of the steps they can take to help reduce this amount. First, they must be familiar with the types of energy used in their homes. Next, they should be aware that in most cases they can determine the amount of energy used by learning to read electric, gas, and oil meters. Comparing beginning and end readings will give them the amount of energy consumed. The following is an example of an "electricity watch". (This family uses a lot of electricity in one week.)

Start	6	5	8	0	Daily Total
Day 1	6	6	1	6	36
Day 2	6	6	6	2	46
Day 3	6	7	0	2	40
Day 4	6	7	3	5	33
Day 5	6	7	9	0	55
Day 6	6	8	3	4	44
Day 7	6	8	7	0	36
Total energy for the week					290

Electrical meters record in units called kilowatt hours. 1 kW•h (kilowatt hour) is 1000 W (watts) of electricity converted in 1 h. It is the power required to burn a 100 W light bulb for 10 h or to operate an electric clothes dryer for 12 min. Most electric meters have four dials, the dial on the right being the lowest value. Meters record only one-tenth of the energy used; thus, each reading must be multiplied by ten in order to determine the amount of energy used. Some of the dials turn clockwise, others counter-clockwise. When helping students to read the dials, remind them that when the dial pointer is between two numbers, they should read the smaller of the two. The dials of the gas meter are similar to those of the electric meter, except that the reading must be multiplied by 100 to get the number of cubic feet used.



Source: Adapted from Ontario Hydro, *Worth Watching* (Toronto: Ontario Hydro, 1977), p. 2.

The thermostat controls the operating temperature of the furnace. For every degree of temperature above the setting of 20°C, your heating-fuel consumption will rise by about 1.3%.

Keeping watch on energy usage in the home is worth while for both children and their parents. They will soon become aware of the major energy users in the home and take steps to develop rules to cut back on their overuse.

Table J3.4 lists the common household energy users, their average wattage, and the kilowatt hours each uses if operated for 1 h. The final column gives the average number of kilowatt hours used in a month. (Electricity presently costs about 3.5 cents per kilowatt hour. Children can calculate the monthly operating costs of each appliance.) It is easy to see from the table which are the heavy electricity users.

Table J3.4: Appliance Wattage

Appliance	Average Wattage	kW•h/1 h	Est. kW•h/ Per Month
Heavy			
Water heater	1000-4500	1.0-4.5	200-800
Range			
– Small element	1250	1.25	
– Large element	2600	2.6	30-225
– Oven	3000	3.0	
Refrigerator	500	0.5	80-220
Air conditioner			
– Window	1000-1400	1.0-1.4	60-870
Furnace fan	185	0.185	55-145
Medium			
Electric clothes dryer	5000	5.0	15-350
Car block heater	450	0.45	20-135*
Kettle	1500	1.5	5-90
Colour TV	330	0.33	20-110
Light			
Dishwasher	1500	1.5	10-50**
Clothes washer	300	0.3	5-60**
Radio (solid state)	5	0.005	1-3
Table lamps	60-100	0.06-0.1	5-15

*If a car heater is used, upper limit may increase to 350.
**Note: large hot water users (included in water heater above).

Source: Adapted from Ontario Hydro, *Worth Watching* (Toronto: Ontario Hydro, 1977), p. 8.

Before introducing this activity, you may wish to construct a cardboard electrical meter with movable pointers. Students could practise reading the meter in a group.

Follow-up Activities

1. Have your students compare among themselves their families' electrical energy usage. Have them calculate the per-person usage and then compare these figures in order to determine which families consume the most energy and what the reasons for this might be.

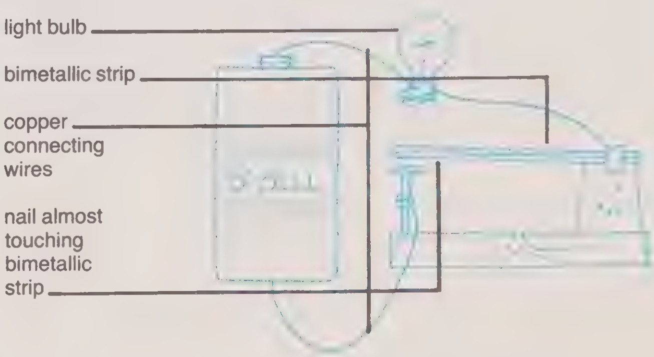
2. Have a "Who Can Save the Most" week. Each student can keep a one-week record of his or her family's energy use. Two weeks later the activity should be repeated, after the students have had a chance to develop ways of conserving energy in their homes. Give a ribbon to the winner.

Related Ideas

1. Have your students interview people to find out how they think energy can be saved in the home.

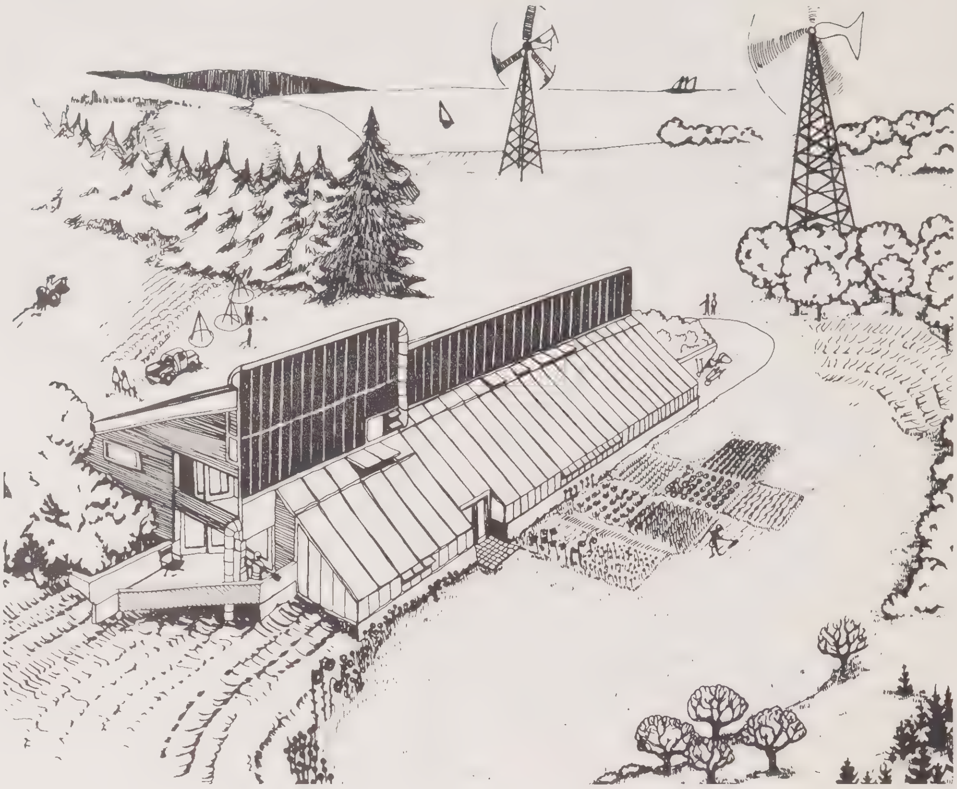
2. Have your students conduct studies similar to those they did at home on the school's metering systems. To get started, ask them the following questions: Where does the energy enter the school? What can the school do to reduce energy usage? Is it possible to measure the lowering of energy use in the school in the same way the activity was done at home?

3. Children may wish to investigate the way in which a thermostat operates and the principle of the bimetallic bar. Your school may have a commercially produced bimetallic strip or you can make one by gluing together with epoxy glue two strips of different kinds of metal, such as a strip from an aluminum pie plate and one from a tin can. By heating the strip, the children will see that it bends because the metals expand at different rates. The thermostat contains a bimetallic strip that bends according to the amount of heat in the room. When the setting of the thermostat is adjusted, an electrical circuit is broken or completed by the bending of the strip. This electrical circuit operates the furnace.



Name:

What Am I Going to Live In?



What will your future home be like? It's hard to imagine. Maybe it will be something like this one.

This is a drawing of an experimental home built in Prince Edward Island. It provides the people who live there with shelter, warmth, and food. It takes care of its own energy needs by using wind and solar power. It is also designed so that it will not pollute or produce unused waste. It is called "The Ark". Why is this a good name for this type of home?

Design your home of the future. On a piece of paper, sketch it.

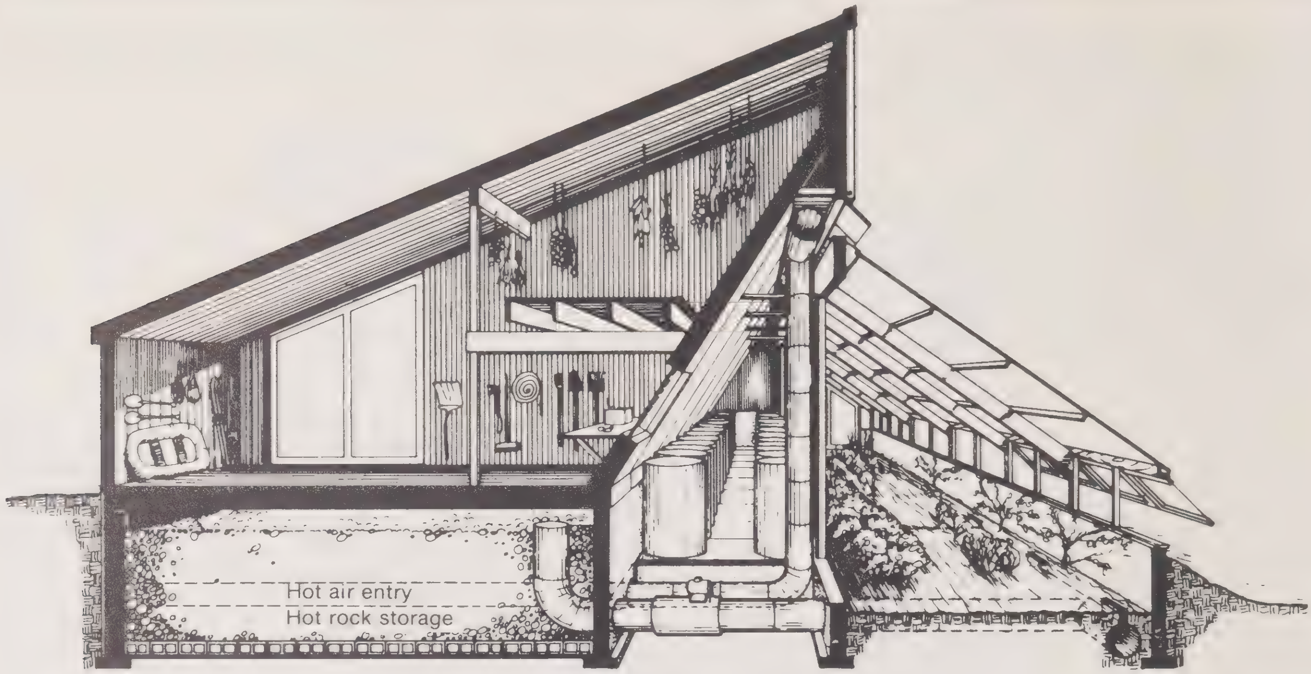
1. Of what materials is it made? ______________________
2. What will it use for heating and cooling? ______________________
3. Is it moveable? ______________________
4. What types of openings are there for letting in light or keeping it out? ______________________
5. What would generate electricity? ______________________
6. How are your food needs taken care of? ______________________
7. Where would your home be located? ______________________
8. Why would living in your home be enjoyable? ______________________

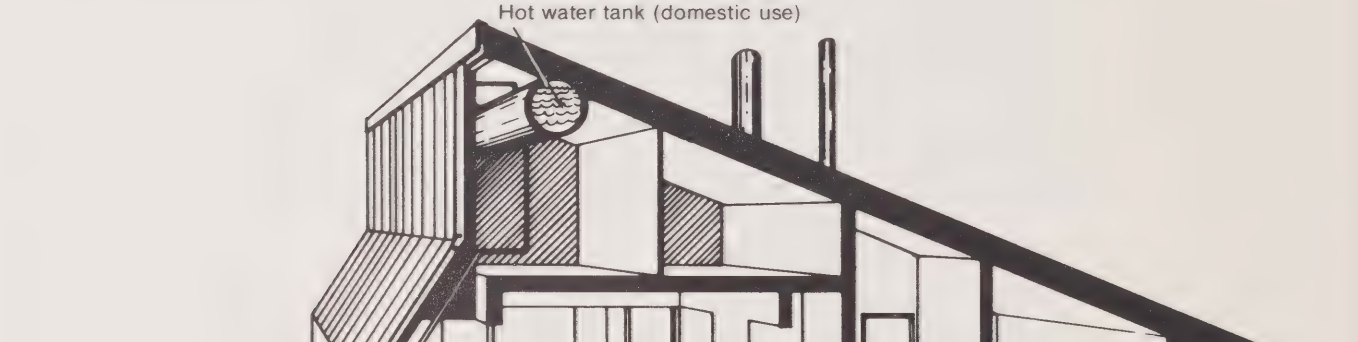
Notes

This activity allows the student to use the knowledge gained from previous experiences in this unit to design and build a model of a future home that will be environmentally self-sufficient. Future lifestyles may be dependent on our need for planning and testing such projects.

"The Ark" was chosen as an example of a carefully designed project which would serve our complete living needs. The Ark uses solar panels and greenhouses for collecting and storing its heating needs; wind energy to generate electrical power; and its own greenhouses to grow algae, fish, and the more conventional vegetables, fruit, and nuts. Using this model of a self-sufficient home, its developers, the New Alchemy Institute, hope to show how complete communities could be adapted to exist without fossil fuels and chemical fertilizers.

Source: Minister of Supply and Services, Canada, *A Most Prudent Ark*, Catalogue No. EN21-21/1977, pp. 4, 7.





Source: Minister of Supply and Services, Canada, *A Most Prudent Ark*, Catalogue No. EN21-21/1977, pp. 4, 7.

Other examples of energy-self-sufficient homes exist in Ontario, although none has been developed to the extent of the Ark. Solar-heated homes exist near King City and in Mississauga, Toronto, Aylmer, Thunder Bay, Sudbury, and Ottawa. Applewood School in St. Catharines is a solar school. New ideas and technology are constantly being developed and tested. Get in touch with a local architect who can tell you where your class might be able to visit a solar-heated home.

Follow-up Activities

1. a) Have students build models using the sketches they drew of their future homes. Frames could be built from popsicle sticks and covered with different building materials. A variety of shapes and colours could be used.

b) Have the students test the energy efficiency of the inside of each building by inserting a thermometer inside the building. A 100 W light bulb is then directed on the structure. Ask your students to answer the following questions: How many degrees does the temperature rise in 5 min? What types or shapes of building have the best heat gain? How is this knowledge helpful in cold climates like Ontario's?

2. Have the children write a story about how their lives might change if they lived in a solar-heated home. Have them extend this story to deal with living in a totally self-sufficient home, which they would never have to leave. Ask them how they would like this type of home.

Related Ideas

1. Take your class to visit a solar home if one is nearby. Ask your students to find out what the solar energy is used for in the home.

2. Invite a building inspector to talk to your class about how local municipalities are changing building regulations to prepare for future energy needs (e.g., right to the sun, home insurance, neighbourhood problems).

Selected Resource Material

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Circuit. The complete path through which an electric current is carried.

Electricity. Energy derived from electrons in motion.

Energy. The potential force that gives us the capacity to do work or produce a change in temperature.

Frequency. The rate at which electromagnetic waves (and other waves) are produced per unit of time.

Heat. Molecular energy possessed by a substance which can be transmitted by conduction, radiation, or convection.

Insulation. A material, such as fibreglass, which does not readily conduct heat energy.

Kilowatt. The unit of power equal to 1000 W (see *Watt*).

Power. The rate at which energy is used or generated, measured in terms of base units called *watts*.

Radiation. A method of heat transfer. Infrared rays warm an object through contact with objects or the air.

Solar energy. The energy produced by the thermonuclear reactions of the sun.

Temperature. A measure of the degree of heat caused by the average molecular motion of the individual molecules in a substance.

Thermostat. A device that controls the heating or cooling of a space by sensing the temperature of the surrounding air and causing a heating or cooling mechanism to operate.

Watt. The SI unit of measurement by which power is measured. It is equivalent to one joule per second.

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